Application No.: 10/820,054

REMARKS

This Amendment is filed in response to the Office Action dated June 14, 2007. For the following reasons, this application should be allowed and the case passed to issue. No new matter is introduced by this amendment. The amendment to the claims is supported throughout the specification and claims as originally filed. For example, the amendments to claims 1 and 4 are supported by originally filed claim 3 and the specification at page 13, lines 6-8. Support for the amendments to claims 18 and 19 are supported by the specification at page 5, line 17 to page 6, line. Claims 20 and 21 are supported by the specification at page 13, lines 6-8.

Claims 1-24 are pending in this application. Claims 1-24 are rejected. Claims 1, 3, 4, 5, 18, 19, 20, and 21 have been amended in this response.

Claim Rejections Under 35 U.S.C. § 112

Claims 1, 18, and 19 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

Claims 1, 18, and 19 have been amended to correct the asserted informalities.

Claim Rejections Under 35 U.S.C. § 103

Claims 1-6, 8, 10, 12, 14, 16, and 21-24 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ryu et al. (US 6,521,380) in view of Brodd (US 5,522,955).[1] This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested. The following is a comparison between the invention, as claimed, and the cited prior art.

An aspect of this invention, per claim 1, is an anode electrode for a secondary battery having a cathode and an anode for releasing and receiving lithium ion therebetween comprising

[1] Claims 1-3, 6, 8, 10, and 22-24, and 4, 5, 12, 14, 16, and 21 were rejected in two separate rejections in the office action.

an anode formed from a single layer of an anode material, the anode material comprising boron-added amorphous carbon containing at least carbon and boron. The single layer forming the anode layer has a thickness of 30 μm or less.

Another aspect of the invention, per claim 4, is an anode electrode for a secondary battery having a cathode and an anode for releasing and receiving lithium ion therebetween, comprising an anode layer formed from a single layer of an anode material, the anode material comprising carbonaceous material containing amorphous carbon. The single layer forming the anode layer has a thickness less than 1 μm.

The combination of Ryu et al. and Brodd does not suggest the claimed anode electrode or lithium ion secondary battery because Ryu et al. and Brodd do not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1, and the anode material comprising carbonaceous material containing amorphous carbon, as required by claim 4.

Ryu et al. disclose a rechargeable lithium battery comprising a negative electrode containing a graphite-based active material with boron as a donor. Ryu et al., however, fail to disclose or suggest the anode material comprising boron-added amorphous carbon containing at least **amorphous carbon** and boron, as required by claim 1, and the anode material comprising carbonaceous material containing **amorphous carbon**, as required by claim 4.

In the Office Action (page 5, lines 1-3 and page 9, lines 1-3), the Examiner asserted that Ryu et al. teach that the carbon-based materials can be largely classified into two categories of crystalline graphite and amorphous carbon. Ryu et al. disclose negative electrodes containing the graphite-based active material, but do not disclose that **amorphous carbon** is used as the negative electrode active material.

Further, Ryu et al. disclose that "boron doped graphite-based active material is formed with a core having a crystalline-graphitic structure and a carbon surface having a turbo-stratic structure. . . . The turbo-stratic structure is characterized by a quasi-amorphous state and a more or less disordered orientation due to a radically low crystallization degree and a tiny crystalline size" (column 2, lines 54-65). However, the quasi-amorphous state of graphite is different from amorphous carbon. The quasi-amorphous state of graphite is a state in which an orientation of **crystal planes** of the graphenes is disordered (see attached Exhibit 1). In contrast, amorphous carbon is defined as "*carbon material* without long-range crystalline order. Short range order exists, but with deviations of the interatomic distances and/or interbonding angles with respect to the graphite lattice as well as to the diamond lattice" (see attached Exhibit 2 – printout of IUPAC Compendium of Chemical Terminology for amorphous carbon). For the Examiner's convenience, a copy of the printout of IUPAC Compendium of Chemical Terminology for graphite is also attached (see Exhibit 3). As is well-known, graphite has long range order.

In view of the differences between graphite, quasi-amorphous, and amorphous carbon, and the express teachings of Ryu et al., it is readily apparent that Ryu et al. do not suggest the anode material comprising boron-added amorphous carbon containing at least **amorphous carbon** and boron, as required by claim 1, and the anode material comprising carbonaceous material containing **amorphous carbon**, as required by claim 4. Brodd does not cure the deficiencies of Ryu et al. as Brodd also does not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1, and the anode material comprising carbonaceous material containing amorphous carbon, as required by claim 4.

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Claims 7 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ryu et al. in view of Brodd and further in view of Hossain (US 5,595,839).[2] This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The combination of Ryu et al., Brodd, and Hossain does not suggest the claimed lithium ion secondary battery because Hossain does not cure the deficiencies of Ryu et al. and Brodd. Hossain does not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1, and the anode material comprising carbonaceous material containing amorphous carbon, as required by claim 4.

Claims 9 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ryu et al. in view of Brodd and further in view of Izuchi et al. (US 6,902,848).[3] This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The combination of Ryu et al., Brodd, and Izuchi et al. does not suggest the claimed lithium ion secondary battery because Izuchi et al. do not cure the deficiencies of Ryu et al. and Brodd. Izuchi et al. do not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1, and the anode material comprising carbonaceous material containing amorphous carbon, as required by claim 4.

Claims 11 and 17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ryu et al. in view of Brodd and further in view of Nemoto et al.[4] (US 6,368,750). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The combination of Ryu et al., Brodd, and Nemoto et al. does not suggest the claimed lithium ion secondary battery because Nemoto et al. do not cure the deficiencies of Ryu et al. and

[2] Claims 7 and 13 were rejected in two separate rejections in the office action.
[3] Claims 9 and 15 were rejected in two separate rejections in the office action.
[4] Claims 11 and 17 were rejected in two separate rejections in the office action.

Brodd. Nemoto et al. do not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1, and the anode material comprising carbonaceous material containing amorphous carbon, as required by claim 4.

Claims 18 and 19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ryu et al. in view of Brodd and further in view of Matsubara et al.[5] (US 6,641,955). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The combination of Ryu et al., Brodd, and Matsubara et al. does not suggest the claimed lithium ion secondary battery because Matsubara et al. do not cure the deficiencies of Ryu et al. and Brodd. Matsubara et al. do not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1, and the anode material comprising carbonaceous material containing amorphous carbon, as required by claim 4.

Claim 20 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ryu et al. in view of Brodd and further in view of Ishida et al. (US 2002/0006552). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The combination of Ryu et al., Brodd, and Ishida et al. does not suggest the claimed lithium ion secondary battery because Ishida et al. do not cure the deficiencies of Ryu et al. and Brodd. Ishida et al. do not suggest the anode material comprising boron-added amorphous carbon containing at least amorphous carbon and boron, as required by claim 1.

The dependent claims are allowable for at least the same reasons as the respective independent claims from which they depend and further distinguish the claimed anode electrodes and lithium ion secondary batteries.

[5] Claims 18 and 19 were rejected in two separate rejections in the office action.

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In view of the above amendments and remarks, Applicants submit that this case should be allowed and passed to issue. If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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EXHIBIT 1

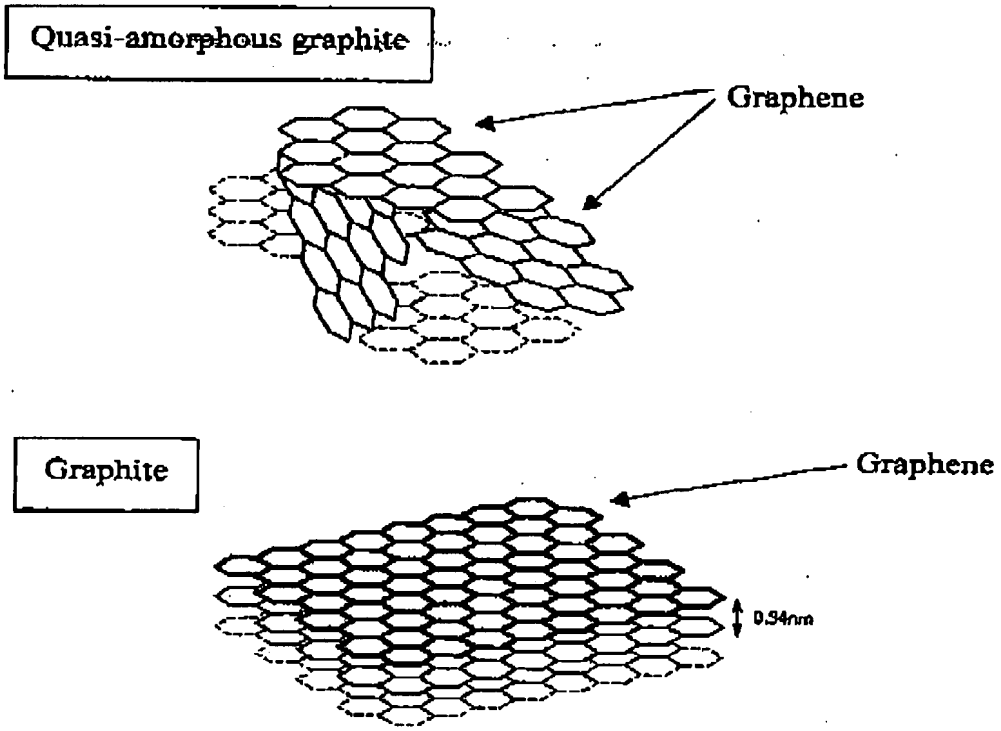
Quasi-amorphous graphite
Graphene
Graphite
Graphene
0.34nm

EXHIBIT 2

amorphous carbon

A *carbon material* without long-range crystalline order. Short-range order exists, but with deviations of the interatomic distances and/or interbonding angles with respect to the graphite lattice as well as to the diamond lattice.

Notes:

The term amorphous carbon is restricted to the description of carbon materials with localized π-electrons as described by P.W.Anderson (*Phys. Rev.*, 1958, *109*, 1492). Deviations in the C–C distances greater than 5% (i.e. $\Delta x/x_0 > 0.05$, where x_0 is the inter-atomic distance in the crystal lattice for the sp^2 as well as for the sp^3 configuration) occur in such materials, as well as deviations in the bond angles because of the presence of 'dangling bonds'.

The above description of amorphous carbon is not applicable to carbon materials with two-dimensional structural elements present in all pyrolysis residues of carbon compounds as polyaromatic layers with a nearly ideal interatomic distance of $a \approx 142$ pm and an extension greater than 1000 pm.

See also *diamond-like carbon films.*

1995, *67*, 477

EXHIBIT 3

graphite

An allotropic form of the element carbon consisting of layers of hexagonally arranged carbon atoms in a planar condensed ring system (*graphene layers*). The layers are stacked parallel to each other in a three-dimensional crystalline long-range order. There are two allotropic forms with different stacking arrangements, hexagonal and rhombohedral. The chemical bonds within the layers are covalent with sp^2 hybridization and with a C–C distance of 141.7 pm. The weak bonds between the layers are metallic with a strength comparable to van der Waals bonding only.

Notes:

The term graphite is also used often but incorrectly to describe *graphite materials*, i.e. materials consisting of *graphitic carbon* made from carbon materials by processing to temperatures greater than 2500 K, even though no perfect graphite structure is present.

1995, *67*, 491